CLAIMS

WHAT IS CLAIMED IS:

1. A method of extraction of at least one sinusoidal component of an input signal, comprising the steps of

estimation of the amplitude of the sinusoidal component of the input signal;

estimation of the frequency of the sinusoidal component of the input signal;

estimation of the total phase of the sinusoidal component of the input signal;

synthesization of the sinusoidal component of the input signal based upon the estimations; and

estimation of an error signal representing the difference between the input signal and the sinusoidal component, wherein:

the sinusoidal component of the input signal is the desired component of the input signal to which convergence is sought and specification of which is accomplished by predetermination of its frequency, and the error signal is the totality of the undesired components present in the input signal.

2. A method of extraction of sinusoids as defined in claim 1 wherein the step of estimation of the amplitude comprises a first integration of a first product of the error signal and a sine, or a cosine, of the total phase of the sinusoidal component of the input signal, scaled by a first scaling factor,

wherein:

the value of the initial condition of the first integration is a real number; and

the first scaling factor is a positive number.

3. A method of extraction of sinusoids as defined in claim 2 wherein the step of estimation of the amplitude further comprises refining of the estimated value of the amplitude

of the sinusoidal component of the input signal by using a first low pass filtering within the first integration.

4. A method of extraction of sinusoids as defined in claim 1 wherein the step of estimation of frequency comprises a second integration of a second product of the error signal, the amplitude of the sinusoidal component of the input signal, and a cosine, or a sine, of the total phase of the sinusoidal component of the input signal, scaled by a second scaling factor,

wherein:

the value of the initial condition of the second integration is a positive number; and

the second scaling factor is a positive number.

5. A method of extraction of sinusoids as defined in claim 4 wherein the step of estimation of the frequency further comprises refining of the estimated value of the frequency of the sinusoidal component of the input signal by using a second low pass filtering within the second integration.

6. A method of extraction of sinusoids as defined in claim 4 wherein the second product is the product of the error signal and a cosine, or a sine, of the total phase of the sinusoidal component of the input signal.

7. A method of extraction of sinusoids as defined in claim 1 wherein the step of estimation of the total phase comprises a third integration of a summation of frequency of the sinusoidal component of the input signal and scaled by a third scaling factor of the time-derivative of the frequency of the sinusoidal component of the input signal,

wherein:

the value of the initial condition of the third integration is a real number, and the third scaling factor is a positive number, or zero.

8. A method of extraction of sinusoids as defined in claim 1 wherein the step of synthesization of the sinusoidal component of the input signal comprises a third product of the sine, or the cosine, of the total phase of the sinusoidal component of the input signal and the amplitude of the sinusoidal component of the input signal.

9. The method of extraction of sinusoids as defined in claim 1 further comprising the steps of:

filtering the input signal to generate a filtered input signal;

correcting amplitude and phase of the sinusoidal component based upon the sinusoidal component of the filtered input signal.

10. The method of extraction of sinusoids as defined in claim 1, further comprising:

extracting a plurality of sinusoidal components from the input signal.

11. A method of elimination of at least one sinusoidal component of an input signal comprising the steps of extraction of the sinusoidal component of the input signal according to the method defined in claim 1; and

subtraction of the sinusoidal component of the input signal from the input signal by the use of a second subtraction.

12. The method of claim 11 further comprising:

extracting a sinusoidal component from the artifact-free input signal.

13. A system for the extraction of at least one sinusoidal component of an input signal, comprising:

(a) means for estimation of the amplitude of the sinusoidal component of the input signal by a first integration of a first product of an error signal and a sine, or a cosine, of the total phase of the sinusoidal component of the input signal, scaled by a first scaling factor,

(b) means for estimation of the frequency of the sinusoidal component of the input signal by a second integration of a second product of the error signal, the amplitude of the sinusoidal component of the input signal, and a cosine, or a sine, of the total phase of the sinusoidal component of the input signal, scaled by a second scaling factor;

(c) means for estimation of the total phase of the sinusoidal component of the input signal by a third integration of a summation of the frequency of the sinusoidal component of the input signal and scaled by a third scaling factor of time-derivative of the frequency of the sinusoidal component of the input signal;

(d) means for synthesization of the sinusoidal component of the input signal by a third product of the sine, or the cosine, of the total phase of the sinusoidal component of the input signal and the amplitude of the sinusoidal component of the input signal; and

(e) means for estimation of the error signal representing the difference between the input signal and the sinusoidal component of the input signal by a first subtraction.

14. A system for the extraction of sinusoids as defined in claim 13 wherein the means for estimation of amplitude is operable for refining the estimated value of the amplitude of the sinusoidal component of the input signal by a first low pass filter incorporated within the first integration.

15. A system for the extraction of sinusoids as defined in claim 13 wherein the means for estimation of the frequency is operable for refining the estimated value of the frequency of the sinusoidal component of the input signal by a second low pass filter incorporated within the second integration.

16. A system for the extraction of sinusoids as defined in claim 13 wherein the means for estimation of the frequency is operable for refining the estimated value of the frequency of

the sinusoidal component of the input signal by a second low pass filter incorporated within the second intergration.

17. A system for the extraction of sinusoids as defined in claim 13 further comprising:

means for correcting the amplitude and phase of the sinusoidal component of the filtered input signal based upon the frequency of the sinusoidal component of the filtered input signal.

18. A system for the extraction of sinusoids as defined in claim 13 wherein the second product is the product of the error signal and a cosine, or a sine, of the total phase of the sinusoidal component of the input signal.

19. A system of extraction of sinusoids as defined in claim 13 wherein at least one of the first or second subtraction, the first, second or third integration, the first, second or third product, the first, second or third scaling, the summation, the sine or the cosine operations is implemented as analog circuitry.

20. A system of extraction of sinusoids as defined in claim 13 wherein at least one of the first or second subtraction, the first, second or third integration, the first, second or third product, the first, second or third scaling, the summation, the sine or the cosine operations is implemented as digital circuitry.

21. A system of extraction of sinusoids as defined in claim 13 wherein at least one of the first or second subtraction, the first, second or third integration, the first, second or third product, the first, second or third scaling, the summation, the sine or the cosine operations is implemented as a software program.

22. A system of extraction of sinusoids as defined in claim 13 further comprising:

means for subtraction of the sinusoidal component of the input signal from the input signal.

23. A system of extraction of sinusoids as defined in claim 13 further comprising:

means for generating an artifact-free input signal.

24. A system of extraction of sinusoids as defined in claim 13 further comprising:

means for the multiple extraction of sinusoidal components of the input signal.

25. An audiometer comprising:

a probe operable to detect a signal responsive to a stimulus signal communicated to a testing subject;

a signal processing unit coupled to the probe for receiving the signal, the signal processor including a core unit for the extraction of at least one sinusoidal component of the received signal based upon an estimation of the amplitude, phase and frequency of the sinusoidal component and a predetermination of the frequency of the sinusoidal component.

26. The audiometer of claim 25, wherein the received signal comprises a steady-state evoked response signal.

27. The audiometer of claim 25, wherein the received signal comprises a transient evoked response signal.

28. The audiometer of claim 25, wherein the received signal comprises a distortion product otoacoustic emission.

29. The audiometer of claim 25, wherein the probe comprises a transducer for communicating the stimulus signal to the testing subject and a receiver for detecting the response signal.

30. The audiometer of claim 29, wherein the transducer comprises a speaker.

31. The audiometer of claim 29, wherein the receiver comprises a microphone.

32. The audiometer of claim 29, wherein the receiver comprises an electrode.

33. The audiometer of claim 25, further comprising a data acquisition unit coupled between the probe and the signal processing unit, the data acquisition unit adapted to condition at least one of the stimulus signal and the response signal.

34. The audiometer of claim 33, wherein the data acquisition unit comprises a filter coupled between the probe and the signal processing unit.

35. The audiometer of claim 25, wherein the signal processor comprises a plurality of core units, each of the plurality of core units arranged to extract a corresponding sinusoidal component.

36. The audiometer of claim 25, wherein the signal processor comprises a first core unit arranged to extract a sinusoidal component associated with an artifact signal and a second core unit arranged to extract a sinusoidal component associated with the response signal.

37. The audiometer of claim 36, wherein the signal processor wherein the second core unit is operable on difference of the sinusoidal component associated with an artifact signal and the received signal.

38. The audiometer of claim 25, wherein the core unit is implemented in analog circuitry.

39. The audiometer of claim 25, wherein the core unit is implemented in digital circuitry.

40. The audiometer of claim 25, wherein the core unit is implemented in software.